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ABSTRACT

This unit on pollution is one in a series of three prepared for use in the classroom. An interdisciplinary approach encompassing mathematics, science, and social studies is utilized in these environmental units. The material is designed for middle grades and above. Many activities are open-ended with each activity in this unit emphasizing the pollution crisis. The unit is divided into mini-units dealing with air, litter, noise, and water pollution. For some of the mini-units, student worksheets are provided which can be easily duplicated. Thought questions are presented to facilitate logical thinking based on skills and knowledge of mathematics, science, and social studies. (JP)

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ENVIRONMENTAL EDUCATION

INSTRUCTIONAL UNIT

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POLLUTION

Department of Public Instruction / North Carolina Department of Public Education

This unit on *POLLUTION* is one in a series of three prepared for use in classrooms in North Carolina. The other two units are on *POPULATION* and *NATURAL RESOURCES*. An interdisciplinary approach encompassing mathematics, science, and social studies is utilized in these environmental units.

This material is designed for middle grades and above. Many of the activities are open-ended. The depth to which students become involved in the utilization of this unit is determined by factors such as grade level, interest of students, and relevance of the material to courses into which it is integrated. The unit is not designed to replace mathematics, science, and social studies; rather, it is hoped that skills previously mastered in these areas will be employed in this unit.

Teachers are encouraged to use discretion in the use of this unit. Some may wish to use it over a period of a few days. Others may wish to expand the activities at the suggestions of students and work with it for several weeks.

The first edition of this unit was written by F. W. Stanly, mathematics teacher, Shelby Jr. High School, Shelby, N. C.; Beverly Crotts, social studies teacher, Trinity Sr. High School, Trinity, N. C.; and Patsy Bohlen, science teacher, Page Sr. High School, Greensboro, N. C. Assistance in writing the three units was provided by the Divisions of Science, Mathematics, and Social Studies of the N. C. Department of Public Instruction. After revision, the unit was field tested and again revised to this final edition.

Division of Science Education
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POLLUTION

Objectives:

1. To create an awareness of pollution with an emphasis on problems at the local level.
2. To develop ecologically sound attitudes that will help minimize future pollution crisis.
3. To utilize skills developed in mathematics, science, and social studies to carry out experiments, solve problems, and explore open-ended activities.
4. To become aware of and incorporate nonpolluting habits into our day-to-day living.

The unit is divided into mini-units dealing with air, litter, noise, and water pollution. Each mini-unit is divided into categories called Looking It Over and Exploring. The teacher may use these mini-units collectively or use them independently of the others, as no set pattern or sequence is mandatory.

Activities and other suggestions for the teacher are:

- given throughout the unit
- flexible, providing for individual differences and for various age levels
- usable either as class assignments or as individual or group work.

In some of the mini-units, student worksheets are provided, which can be easily duplicated.

Thought questions are presented in a way to create logical thinking based on skills and knowledge of mathematics, science, and social studies. Many of the questions are open-ended, providing students with alternative solutions. It is hoped students will be able to recognize the many-sided issues involved in environmental planning.

LITTER POLLUTION

Litter and garbage are not only unpleasant and physically disturbing, but they also affect human health by providing breeding places for flies and other insects, and by polluting the air, water, and land. The cost of cleaning up this pollution will run into millions of dollars each year.

I. WHAT IS LITTER?

A. Looking It Over

1. *Defining litter*

Ask students to name items of litter they frequently see around the school and their home. Write the items on the board or on a transparency as the students name them. When they have named as many as they can, have the students write a definition of litter.* Now have the students list on paper all the items they have contributed to the litter problem in their school and home in the past two days.

**To the teacher:* The list should give them clues to writing a definition. The teacher should have pictures showing litter on the bulletin board and around the room but should not point them out yet, hoping the students will notice on their own.

2. *Things to think about and find out!*

- Why did they discard the items they listed?
- Why did they not put them in a trash container?
- Did they contribute more litter to the school or to their homes? Why?
- How many items did each student have on his list?
- What was the average for the class?
- Who contributed more items? Boys or girls?

B. Exploring

1. *Classwork*

Take students outside to clean up the litter around the school. Assign students to designated areas of the building and grounds.

To the teacher: Classroom, playground area, restrooms, halls, bus loading area, cafeteria, lockers, etc. This should be done near the end of the day.

Bring litter back into the classroom when the groups have finished. Keep each group of litter separated until it has been weighed and the pieces counted and recorded. Then:

- Sort the combined litter on a table into several piles, placing similar objects together.

  To the teacher: ice cream wrappers, writing paper, candy wrappers, milk cartons, fruit peelings, soft drink cans, etc.

- Count the number in each pile.
- Make a chart showing type of litter and amount of each type found. Litter may then be destroyed.

2. *Things to question!*
   - What was the total amount of litter collected (by weight and by number of objects)?
   - Which of the assigned areas had more litter (by weight and by objects)?
   - Why were these areas good locations for litter around the school?
   - What type litter was most common?

C. Going Beyond

1. *On the scene*

   Ask students to bring 3½ pounds of litter to school.

   To the teacher: Assign this 2 or 3 days in advance or give them a weekend to collect it. This may come from their home or community.

   - Sort this material on a table, placing similar items together.
   - Make a graph similar to the previous chart and record the findings.

2. *Things to find out and discuss*

   Use the graph when needed to answer the following questions:

   a. How many types of litter did you find?
   b. Which was the most common type?
   c. Where would this type most likely be found?
   d. Which was the least common type?
   e. What is the percent of each type of litter collected?
   f. What is the difference between litter and garbage?
   g. What items are garbage?
   h. Which is the most harmful, litter or garbage, to our environment? Why?
   i. If each student represents an average household producing approximately 20 pounds of garbage each day, how much would the class produce in 1 week? How much in 1 year?

j. How many tons of garbage would be produced by the class in 1 year?

k. If this average increases by 3 lbs. by 1980, how much garbage will be produced by this class in 1 week? In 1 year?

l. What will be the percent of increase for 1 week? For 1 year?

m. How much litter does the class create in 1 week, based on the national average of 3½ lbs. per person per day? A month? A year?

n. Let each student, using his own family, calculate similar answers.

o. What are the totals for the class?

3. *Follow-through*

Devise a way to dispose of the litter in the classroom.

To the teacher: Use system students suggest.

. Where would they take it? Can the school handle it or do they need to take it to the city disposal?

(Students will need to consult the maintenance staff or janitor to find out what system the school uses to get rid of litter and garbage.)

. Is disposing of the litter the only problem caused by the collection in the classroom?

. What problems does disposal create with air, water, and land?

. Does the school have an incinerator?

. What kind of pollution does an incinerator create?

. What happens to the items that do not burn?

. What items containing natural resources and minerals are being thrown away? (paper, tin, glass, etc.)

. Which items can be recycled?

. What is the process of recycling?

. Is there a recycling plant or organization in the community?

ANSWERS TO PROBLEMS IN PRECEDING "2. *Things to find out and discuss.*"

e. To determine percentage by weights.

(No. of lbs. of particular kind ÷ No. of lbs. of <u>all</u> kinds) x 100%.

Example 1: Suppose from 50 lbs. collected, 3 lbs. are in cans.

$(3 \div 50 \times 100)\% = (300 \div 50)\% = 6\%$

Cans: 6%

ANSWERS TO PROBLEMS (Continued)

Example 2: Suppose from 200 pieces, there is one old car muffler.

$(1 \div 200 \times 100)\% = (100 \div 200)\% = \frac{1}{2}\%$ or .5%

Muffler: $\frac{1}{2}\%$ or .5%

i. To compute weekly amount for class. (N = number of students in class)

$\underbrace{(N \times 20)}_{1 \text{ day}} \times 7 = N \times 140$ lb.

1 week

Using 52 weeks = 1 year

$(N \times 140) \times 52 = (7280 \times N)$ lb.

j. Using 1 lb. = $\frac{1}{2000}$ ton

$(7280 \times N)$ tons $\times \frac{1}{2000}$ tons $= (3.64 \times N)$ tons

k. $(7 \times 3) + (140 \times N)$ lb.

$52\ (21 + 140 \times N)$ lb.

l. $(3 \div 20) \times 100\% = (300 \div 20)\% = 15\%$

Weekly: $\frac{161N - 140N}{140N} = \frac{21N}{140N} = 15\%$

Yearly (by tons): $\frac{4.186N - 3.64N}{3.64N} = \frac{.546N}{3.64N} = 15\%$

m. Weekly: $(3\frac{1}{2} \times 7 \times N)$ lb. $= 24.5N$ lb.
Monthly: $(30 \times 3\frac{1}{2}N)$ lb. $= 105N$ lb.
Yearly: $(12 \times 105N) = 1260N$ lb.

To the teacher:

. Good opportunity to use a community resource person to discuss recycling. Teacher may assign a student or students to do individual projects on recycling and other methods of disposal used by the city or community. Many types of materials can be recycled or returned for use again:

a. Newspapers can be sold to paper companies in 100-lb. lots. Some cities offer $.50/100 lb. for used paper. Other types of paper may be acceptable for recycling too.

b. Glass bottles and jars can be reused by breaking, melting, and remolding them. The Ball Company, 1856 Hendersonville Road, Asheville, N. C. 28803, tel. 704-274-1661, will accept certain types of glass for recycling.

To the teacher: (Continued)

- See The Do It Yourself Environmental Handbook prepared by the Dayton Museum of Natural History. $1.95.
- Check with local environmental action groups to see if additional materials such as metal, no deposit bottles, etc., are being recycled in your city.

II. WHERE IS LITTER FOUND?

A. Looking It Over

1. *On the scene*

Take students on a field trip to observe their community for signs of litter. They need to go to areas where litter is most prevalent as well as to areas relatively litter-free. Include going into some public buildings. Take pictures of these areas to be used now and in making a set of slides for future use.

2. *Map work*

Collectively compile a list of the areas where large quantities of litter and garbage were found on the field trip. On a city or community map, drawn by the students in advance, locate these areas

To the teacher: Along sidewalks, a gully, an alley, along fences, ball parks, beside buildings, outside a drive-in restaurant, along highways, in a bus station, etc.

3. *Things to think about!*

- Is it a rural community or urban area?
- Would this make a difference in the amount of litter?
- Where would there be more litter? Why?
- Are the areas where litter was found different? Why?

B. Exploring

1. *Individual map work*

Have student select one of the areas shown on the city or community map. Then, have student draw a map of his assigned area of the city or community. If he selects a building, he will need to draw the interior, showing rooms, doors, furniture, etc. Be sure maps of outdoor areas indicate correct direction (N-S-E-W). Compasses may be used by the students to determine directions. These maps should show locations of roads, buildings, sidewalks, etc. Select symbols or letters to represent types of litter.

2. *On the scene*

Students should go to their selected sites after school and make a list of each type of litter, and record the amount of each type before disposing of it. At school the next day, have students place symbols for the type and amount of litter in the proper location on their maps.

3. *Follow-up*

Using data from the maps:

- What is the most common litter found in each area?
- What types of litter are found only in one particular area?
- Which areas are most widely used by people?
- Do the most widely used areas indicate any significance of age group? Children, teenagers, or adults?
- Compare the types of litter found in the community with the types of litter found around the school.
- Where would the best location in the community be to erect signs about littering?
- Does the location of litter suggest from which direction the wind blows?
- In which season of the year would there be the most litter? Why?
- Would the day of the week affect the data on your map? Why?
- Would the weather affect the data on your map?

III. WHO ARE THE LITTERBUGS?

A. Looking It Over

1. *On the scene*

Using information previously gathered, have students select areas to observe for identity of litterbugs. Select a time when the area is being used by a lot of people.

Example: When people are coming home from work or during a ball game, etc.

Prepare the observation sheets in advance, to be taken with them to the areas, so they can record their findings.

Checklist should include:

- Is litterbug a child, a teenager, or an adult?
- What type of litter was dropped?
- What time was observation made?
- Was the litterbug male or female?
- Were proper waste containers available which should have been used?

Students should repeat the observations on different days and compare the results.

Example: What were the differences between the results of Saturday and Monday?

2. *Things to discuss*

- How many people were litterbugs?
- Which age group contributed the most litter?
- Which type of litter was contributed most by each age group?
- Do males or females contribute more litter?
- What differences in litter patterns were found on different days?

B. Exploring

1. *On the scene*

Conduct interviews to get the reactions of citizens on litter. Students will want to interview a wide range of people, including professionals, parents, students, factory workers, an observed litterbug, etc. Be sure the questions listed below are included in the interview.

Prepare the questions in advance. These interviews may be taped instead of written, if the students or teacher prefer. The tapes played in class would create an interesting discussion.

Sample questions:

- What is litter?
- Who do you think are the litterbugs?
- What type of litter is most harmful to our environment?
- Are you aware of the pollution problem caused by litter?
- Do you think the laws against littering are effective?
- What do you think can be done to stop littering in our community?

2. *Follow-up*

From these interviews, have students compile their responses on a chart.

- How does the response of the adult differ from the response of the teenager and child?
- Which age group is most aware of the pollution problem?
- Who do they think contributes the most litter, according to the responses?
- What were some good suggestions given during the interviews to stop pollution?

C. Going Beyond

Role-playing

Set up a litter court to try a litterbug. The following roles will be played:

Judge	Litterbug	Sheriff or Arresting Officer
District Attorney	Jury	
Defense Attorney	Clerk of Court	Witnesses to scene of crime

To the teacher:

- Appoint the students or let them volunteer to play the roles. The litterbug and witnesses will not be appointed or be volunteers.
- The Sheriff or Arresting Officer, observing an act of littering by one of the students, makes the arrest. This act will not be planned. The officer will want to make sure other students are around when the crime is committed, so he will have some witnesses.
- Explain the proceedings of a trial to the class before it convenes, so the students will fully understand what is taking place.
- Allow the District Attorney and Defense Attorney one or two days to prepare their cases.
- Carry out the trial as a real court case. The evidence presented will determine the outcome of the case.
- When the trial is ended, the Judge will ask the Jury to leave the room to decide on the verdict of guilty or not guilty.
- The Judge will administer the punishment or acquittal.

  Example: Punishment may consist of cleaning the school grounds for one week.

IV. WHAT CAN BE DONE ABOUT LITTER?

A. Looking It Over

Students may write to state legislators expressing their desire that state legislation be enacted to curb pollution. Suggestions should be specific.

B. Exploring

Contact your local law enforcement office to obtain facts dealing with litter problems. Obtain the following information:

- Number of arrests made for littering in 1962, 1968, 1970, 1972.
- Number of convictions for the same years.

Students may record this on a graph. Using the graph, discuss:

- Has there been an increase or decrease in arrests over the past 10 years?

- Has there been an increase or decrease in arrests in the last 2 years? In the last 4 years?
- How do the number of convictions compare with the number of arrests? Compare with the same years as above.
- What conclusions can be drawn from this study?

C. Going Beyond

Using the information and data previously compiled on litter, begin to formulate ways to correct and solve these problems. One way to do this is through role-playing.

- Appoint or let students volunteer to play the roles of the Mayor and City Council members.
- The other students can be interested citizens of the city. They may write letters requesting the Council to take action on pollution problems and may also appear at Council meetings to present their requests.
- Students will want to invite resource people from the community to come in and speak at the Council meetings.

  Example: A qualified person to speak on the process of recycling or a member of the Health Department.

- Interested citizens may debate the proposals at public Council hearings. Research will be needed on many of the proposals.
- Encourage the Council to vote on all proposals presented. Be sure the Council members study these proposals, considering such things as costs of implementing a new program and enforcement of laws, etc.

To the teacher: You may use the form of government your city or county has. The goal is the same--passing laws or ordinances to protect the environment. It is hoped that many of the class suggestions will be passed on to the local government.

A field trip may be taken to a City Council meeting. The Council should be informed previously about the unit of study and what has been done.

AIR POLLUTION OR WHAT HAVE THEY DONE WITH THE SUN?

I. WHAT ARE THE SOURCES OF AIR POLLUTION?

A. Looking It Over

Air pollution is caused by particles in the air resulting mostly from windstorms and the burning of materials. Particles exist in the gaseous form as well as solids.

Fossil fuels (oil, gas, and coal) are formed as a result of plants and animals dying years ago. Over long periods of time and great pressure, the remains of plants and animals were converted into petroleum products. The burning of fossil fuels causes soot and harmful gases to be released into the air.

B. Exploring

1. *Materials:* cross-sectional map of earth's layers, fossil prints of plants in rocks

   Examine a geological chart of the earth.

   . Find areas of gas, coal, and oil deposits in the U. S. A.

   Examine plant fossils in rocks.

   . What caused the impression?
   . Why is the plant no longer there?
   . What are fossil fuels?
   . Why are oil, gas, and coal called fossil fuels?

2. Locate industries, businesses, and institutions which produce a lot of air pollution.

   Try to get answers to the following questions:

   . What kind of fuel do they use?
   . Does the company use any kind of filters to prevent unnecessary emissions?
   . Would converting to a different kind of fuel reduce pollution?

3. We are rapidly using up our fossil fuel supply. Yet it seems that we always find more and more uses for our fuel.

   Ask the class to list which of the many items operated by fuels are necessities and which are luxuries. You may find conflicting ideas on what is "necessity" and which are "luxuries." For example:

Necessity	Luxury
automobile	power mower
electric iron	hairdryer

   Note: Imagine what the necessity and luxury lists would have been like if they were written 50 years ago, 30 years ago, and 30 years into the future.

   . Is it possible to decrease our demand for more fuel?

4. An experiment can be devised to collect dust particles.

   . Using squares of glass or plexiglass, place strips of tape which are sticky on both sides (or Scotch tape formed into an inverted circle) on them. A thin coat of vaseline could be smeared on the glass instead of sticky tape. (If glass is not available, sturdy cardboard covered with plastic wrap may be substituted.)

   . Place the dust collectors in a variety of places to see where the most particles fall. Keep a careful record of the location of these plates.

   . After one day, collect the plates and examine with a hand lens or microscope. Try to identify the particles and record the proportions of each (pollen, rock particles, fly ash, hair, dust, rubber, etc.).

   . Compare the areas where different plates were placed for the type of pollution each has.

II. WHAT IS THE DANGER OF AIR POLLUTION?

A. Looking It Over

Air pollution is dangerous to living organisms. Poisonous gases and particles in the air aggravate respiratory diseases, kill animals, and cause plants' leaves to yellow, curl up, and wilt.

B. Exploring

1. *Materials:* car, large plastic garbage disposal bags, rubber bands

   . Select a large American-made automobile. Instruct the students to fasten a large plastic garbage bag over the cool tailpipe of the car. Secure the bag in place with a rubber band or string. An adult should start the car and let it idle while the students time how long it takes to inflate the bag. When completely filled, the bag will be blown off the tailpipe. Repeat the experiment, holding the gas pedal down halfway. Now conduct both parts of the experiment with a small foreign car. Compare the times recorded to see which situation made the bag blow off fastest. This will be the situation that causes the most air pollution.

   . Make a chart of your results.

   . How would an untuned car compare with a well-tuned car?

   . Is car size a factor in air pollution?

   . Is driver behavior a factor in air pollution?

2. *Materials:* car, white construction paper

   . Hold a piece of white construction paper a few inches from the auto exhaust pipe. Start the engine, holding the paper in place for 15 seconds. Repeat after the car has been running for a few moments. Have the students look at the color of the paper and smell it.

- Is there any difference in the two papers?
- Does "short hop" city driving pollute more than sustained driving?

3. *Materials:* car, plants, coat hangers, plastic bags, hose

   - Select a crop plant such as tomatoes or beans or commercially grown plants such as flowers. Bend a wire coat hanger to act as a frame over the top of the plant. Place a plastic bag over frame and plant. Introduce auto exhaust into plant's miniclimate by attaching a hose to the exhaust pipe and running it under the plastic. Reintroduce exhaust fumes daily. Prepare a second plant with plastic cover as a control.
   - Do the leaves change color? In the middle or the edges first?
   - Do the leaves wither?
   - Take a field trip along a roadway. Observe the plants close to the road.
   - Observe plants near a bus stop.
   - Learn to recognize the effects of air pollution on plants.

   Note: White pine seedlings are good indicators of pollution in the air.

4. Many disasters have occurred as a result of air pollution.

   - Ask the students to research one or more of these events:

     October 1948--Donora, Pennsylvania
     December 1952--London, England
     November 1969--Chicago, Illinois

   Hint: The New York Times is usually on microfilm in municipal libraries.

   - Then, following the research work, center a class discussion on the following questions:

     a. What causes an inversion layer?

     b. Has air pollution ever been listed as a cause of death or a contributing cause on a death certificate?

        Note: Check with local mortician or coroner.

     c. How are respiratory diseases effected by air pollution?

        Note: Invite a speaker from the Tuberculosis and Respiratory Disease Association to give medical information.

5. Devise a survey to determine attitudes of people concerning air pollution problems. It is necessary to survey a large number of people in order to get an idea of the community feelings. Be sure to include people of all ages, races, and sexes in your survey. Each student could survey ten people and the class could compile the results.

Sample questions are listed below:

- Would you be willing to participate in a car pool to decrease the number of cars on the roads?
- Would you use a city transit system for your transportation?
- Are you willing to walk or ride a bicycle instead of using a car for short distances?
- Would you choose a car with less horsepower to conserve gasoline and prevent air pollution?

6. How much air do we breathe in one day?

   Give balloons to the students in the classroom. Ask them to breathe normally and blow up the balloon with the same amount of air that they take in each breath.

   - Note size differences among the balloons.
   - Calculate the number of breaths taken each minute, hour, day.
   - Determine how many balloonfuls of air each student breathes in a day.
   - Calculate class average.
   - Would exercise for one hour a day change the average?
   - Can the students figure out how to get a more accurate measurement of the amount of air it takes to fill the lungs in one breath?

     Example: Exhale through a straw into a premeasured bottle full of water. Subtract amount of water remaining in jar from original amount.

7. Sources of air pollution.

   Have students make a community survey of some of the major sources of air pollution.

   - Is trash burned at the local dump?
   - Do people burn leaves in the fall?
   - Do industries and power plants emit smoke and gases?
   - How can you tell if the air is polluted if dark smoke is not visible?
   - Can air pollution be completely eliminated? What would the community be like if it were?
   - Can air pollution be reduced? How?

WHAT'S THE SOLUTION TO WATER POLLUTION?

We are constantly polluting one of our most precious natural resources--water. The amount of water on earth has remained constant for millions of years. It is continuously recycled. But man is causing some of it to be polluted so that the amount of water available for human use is rapidly dwindling.

I. WHERE IS OUR WATER?

A. Looking It Over

1. What are some characteristics of water?

   . Provide each student with a container of water, challenging them to observe and record all they can about water. After a short period of time, distribute simple material to them for experimentation (pencil, paper towel, paper clip, cork, salt).

   . Record observations:

odorless	bends light
tasteless	floats wood
colorless	dissolves many items
ripples	heavy items sink

2. With the classroom globe or map, have students locate the bodies of water (lakes, seas, oceans) which are large enough to be marked.

   . Which of these are fresh water?

   . Which are salt water?

   . Can salt water be used for drinking?

   Have students mark the saltwater and freshwater areas on the map or globe.

   . Can you estimate what percent of the earth's water is salty? Fresh?

   . Is all fresh water available for man's use?

3. Have students observe what happens to rainwater in a city, a meadow, a forest, and on the beach.

   . What happens to the water that falls when it rains?

   . Why don't the oceans overflow?

   . What causes rain clouds to form?

   Have students make a water cycle chart showing what happens to rainwater from the time it falls until new clouds are formed.

4. We should all become aware of the many ways we use water each day.

   . Have students take a shower but plug the drain to determine the amount of water used.

      a. Was more or less water used than when taking a bath?

      b. Suggest to the students that they try to minimize the amount.

   . Have students list all the ways they use water each day.

   . Have students, in small groups, investigate what individuals can do to conserve water, and list.

   To the teacher: Compile the lists and discuss. Urge students to incorporate these into daily habits.

   Sample List:

      a. Fix leaky faucets and toilets to conserve water.

      b. Don't run water unnecessarily, as when shaving, brushing teeth, or washing the car.

5. What would we do if we were without water for a week?

B. Exploring

1. Water from ponds, lakes, and oceans evaporates and is returned to the atmosphere. From what other sources does water evaporate and return to the atmosphere?

   Hint: Why is the surrounding countryside cooler than the city on the same day?

2. If the ice caps were to partially melt, would this increase our supply of fresh water?

3. What has to be done to salt water to make it suitable for drinking? Are there any cities that now do this?

II. WHAT IS THE RELATIONSHIP OF PLANTS AND ANIMALS TO WATER?

A. Looking It Over

1. The types of plants and animals present in water can give an indication as to the amount of pollution present. This is because of the different amounts of oxygen present in clean and polluted water.

   . What kinds of plants and animals are found in clean water? In polluted water?

2. *Materials:* microscope or hand lens, strainers (see diagram in Appendix), shovels

   Select a polluted stream and a stream known to be nonpolluted near your school or home. For comparison, perform the same tests on water from each of the streams.

   . Collect minute forms of animal life by filtering stream sediment through screens of increasingly finer mesh.

   . Identify these, using a microscope or hand lens.

3. *Materials:* plankton net, plastic jars or baggies

   Plant material may be collected by using a plankton net. One can easily be constructed (see diagrams in Appendix).

   . Which stream had more forms of plant life?

   . Which stream had greater numbers of animal species?

   . Which stream had a larger growth of algae?

B. Exploring

1. What microscopic animals seem to be indicators of polluted water? Why?

2. Why does an increase in algae (algae bloom) cause fish to die?

III. WHAT IS IN POLLUTED WATER?

A. Looking It Over

1. Some substances dissolve in water and others are suspended or float on top of water. Many industries and businesses contribute to this pollution. Some of the polluting substances are poisonous or otherwise harmful to animals.

   . What substances in water cause pollution?

2. Prepare a display of different types of water contaminates. Place teaspoonfuls of materials in separate containers of water.

   Examples: salt, sugar, food coloring, fertilizer, oil, soil, detergent, etc.

   . How many materials are visible?

   . How many would be harmful if you drank them?

   . How many would support fish life?

   . How many would be unsuitable for recreation such as swimming, skiing, boating?

   . How many teaspoonfuls of the material would it take before the samples would be considered polluted?

   . Develop a definition of water pollution.

3. *Materials:* paper towels, funnel, jar, polluted water

   Filter polluted water through a paper towel and funnel and examine the solute (on the towel) and the solvent (in the jar).

   . Did filtration remove all of the pollution from the water?

   . Allow the jar of filtered water to sit undisturbed for several days. Did any more particles settle out?

   . What are some things that still might make the water look dirty or polluted? Identify any solid materials on the paper towel that you can.

4. *Material:* map of your town

   On a map, locate industries that dump wastes along waterways in or near your town.

   - Find out which industries are the worst polluters and write to them, the City Council, and congressional representatives to express your concern.
   - Take a field trip to visit these places.

5. Read articles about harm done to birds, fish, and other animals through pollution.
   - What effect does crude oil have on birds' feathers?
   - How are their feathers affected by detergents in polluted water?

B. Exploring

1. When ducks preen their feathers, they distribute an oil which their bodies produce. This oil makes their feathers waterproof.

   How do the detergents make the ducks' feathers no longer waterproof?

2. What are some methods presently being used to clean up oil spills? How effective are they?

IV. DO PHOSPHATES AND WATER MIX?

A. Looking It Over

One of the most serious water pollutants is detergents used in laundry and household cleaning. These substances contain phosphates that help produce cleaner washes but have disastrous effects on the plant and animal life in a stream or pond.

1. *Materials:* 3 large jars, algae, sodium phosphate, sodium nitrate

   To study the effects of detergents on algae, set up some small aquariums (large jars). Add various forms of algae from a pond or pet store. Add ½ teaspoonful of phosphate or nitrate to each of two jars. Keep one jar free of chemicals for a control. Add another ½ teaspoonful in three days to the two jars which already have phosphate in them. Observe for four weeks. Record any changes you see.

   Note: Sodium phosphate and sodium nitrate can be obtained from a drugstore.

2. Make a list of laundry detergent brands.
   - What percent of phosphate does each brand contain?
   - Which brand of detergent is most commonly used in the students' homes?
   - How do the enzymes in detergents help remove spots and stains?

3. Take a field trip to observe a stream into which treated sewage flows. Compare this water to water coming from industries, businesses, and homes into the sewage treatment plant.

   . Where did the "suds" come from?

   . Did the sewage treatment have any effect on the foam?

   . What does biodegradable mean?

B. Exploring

1. Some towns have banned the use of all detergents with phosphates above a certain percent. Could your town do the same?

2. Farm fertilizers contain nitrate compounds. What effect could this have on streams in the area?

3. Devise and carry out an experiment to see which detergents produce the most suds or break down fastest in water. Be sure to have a control in your experiment and keep accurate records of what happens.

4. Have students design and construct some apparatus for purifying water. Methods may include:

   filtration through sand, gravel, cloth, cotton
   boiling
   distillation
   chemical purifiers (Clorox)

   . Is water safe to drink because it looks clear after filtering?

   . How does a water treatment plant purify water for a community?

   . Tour your water treatment plant.

   . Summarize: How is water made fit for drinking?

NOISE POLLUTION

The material in this mini-unit is designed to be usable. Student sheets are arranged for easy duplication. For each student activity, there is a teacher commentary. Equipment for the experiments is easily obtainable.

The experiments are not sequential, hence they may be used at the discretion of teachers. Some may prefer to assign all the experiments to all the students; others may elect to differentiate the assignments. In some instances, the teacner may wish to add to or take from an individual assignment.

Questions have been designed to give more than passing emphasis to the social implications. The mathematics needed is basic and within the students' grasp.

I love to go down to the coast
And there a scientist be.
For that is where I see the sound
And also hear the sea.

I. IS NOISE POLLUTION?

A. Looking It Over

To attempt to define noise is to editorialize, because that which is music to one set of ears is noise to another. Regardless of what we call it, man in his progress has created devices which produce sounds. From time-to-time and from place-to-place, those sounds reach such proportions that people are made uncomfortable and may actually be harmed.

Perhaps the first question to occur to students and/or teachers is this:

How can sound be regarded as a pollutant?

Sound, although energy, is like anything else in that it becomes a pollutant whenever it is employed in a manner that endangers the life, property, and comfort of people. When sound gives rise to a hazardous or discomforting situation, we may rightly describe it as noise pollution.

Noise certainly can be a health hazard as is evidenced by the large numbers of workers who have suffered ear damage as the result of high intensity noise in their working environment. Noise pollution should be considered from two aspects, mental and physical.

Physical pollution refers to noises that cause damage to the body. Mental pollution refers to noises that are aggravating. The former type of pollution has been well documented while the latter is undocumented, owing to its highly individualized nature. Many communities are enacting ordinances to control to some extent physical noise pollution. Industrial noises are frequently mental.

MEASURING NOISE
(teachers and students)

Loudness is a subjective measure. To illustrate subjectiveness, you may turn on a radio (or record player) and gradually increase the volume. Ask the students to raise their hands when the sound gets "loud."

Is there a difference in reaction time between the students closest to the source of sound and those farthest away?

Scientists use the word "intensity" to describe the volume of sound. Sounds to be measured are compared to a sound that can barely be heard (threshold of hearing). The unit of measurement is called a decibel. You can get some idea of the relationship between loudness and intensity by examining the following table:*

SOUND	INTENSITY (decibels)
Threshold of hearing	0
Whisper	10-20
Automobile	40-50
Heavy traffic	70-80
Pneumatic drill	90-100
Thunder	110
Threshold of pain	120

*W. J. Jacobson, et al., Inquiry Into Physical Science, American Book Company, New York. 1969. p. 172.

"DO YOUR OWN THINKING"
(commentary for teacher)

Run page 23 through your copier and duplicate enough copies for all of your students. You may elect to discuss some of the points mentioned in MEASURING SOUND on page 28 prior to using this sheet. Give the students enough time to think of and list sounds they like and those noises they dislike. Ask various students to tell one or more of the sounds they have listed, but not the category in which they placed them. Write these sounds on the board. As the sounds are listed on the board, you may ask, "How many of you have this sound listed?" After you have elicited about ten, go back through the list to determine how many students had a given sound listed under "like" and how many under "dislike." You may wish to interject your own opinion each time.

You can isolate several "popular" sounds and several "unpopular" sounds from the scoreboard. Using the decibel table on page 21, have the students guess the decibels of the most popular and least popular sounds.

"DO YOUR OWN THINKING"
(students)

On this sheet, list sounds that you like to hear in the left-hand column. List some noises that you do not like to hear in the right-hand column.

LIKE TO HEAR	DO NOT LIKE TO HEAR

B. Exploring

1. "DON'T JUST SIT THERE, GO EXPLORING"

(commentary for teacher)

This activity is an experiment to find out if listening to a loud sound for a long time affects hearing.

Each experimenter needs a variable intensity sound source and a watch. The experiment extends over three days, but does not require a lot of time each day.

Placing his ear close to the source, the experimenter adjusts the loudness of the sound until it is just less than hurting his ear (the threshold of pain). He listens each day for the time indicated on the data sheet on page 25. Then the watch is held about one foot from his ear and the time required to hear the watch ticking is recorded on his sheet.

Unless you have access to several "listening stations" with individual headsets, you may want this experiment to be done at home, using a radio for the sound source.

The experiment can be done in the classroom using a radio and two or three students to do the listening. In this case, you may prefer to make a transparency of the "DON'T JUST SIT THERE, GO EXPLORING" sheet (page 25).

You can make a master list of places suggested in Item b. on page 25 and "guess" the decibels of the "loud sounds."

"DON'T JUST SIT THERE, GO EXPLORING"

(students)

1. Does listening to a loud sound for a long time affect your hearing?

   Watcha Think? _____

Listen	Hearing Recovery Time
15 seconds	_____
30 seconds	_____
60 seconds	_____

a. Report your findings on a graph in the space above.

b. Think of some places in the community where people listen to loud sounds for a long time.

c. If possible, visit some of the places and see if hearing is affected.

B. Exploring (Continued)

2. "DO IT!"

(commentary for teacher)

This activity is a type of puzzle and can be quite interesting. The activity requires little instruction for the class. Distribute the "DO IT!" sheets (page 27) and tell the class that you are going to play a recording of various sounds for them. Their job is to guess the source of the sounds. After the guessing is done, read the correct identifications. If you wish, you may have the students guess the decibels, using the table on page 21 as a basis.

The only drawback to this activity is acquiring the tape. With a tape recorder, the problem is solved. The teacher can go to various places to record sounds, or two or three students can volunteer for the assignment.

In preparing the tape, the sounds should be preceded with an identifying number. The sound should be recorded for several seconds.

Some suggested sources of sounds: slamming of locker doors, air hammer, power saw, lawn mower, typewriter, automobile, truck, dial tone, telephone bell, running water

"DO IT!"
(students)

The Sounds Around Abound, I Found!

Sound	Source	Decibels
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Number of right guesses _____
(Divide the number of right guesses by 10 and multiply the result by 100 to find your guessing percentage.*)

My guessing percentage is _____%.

Guessing Percentage	Title
0-20	Lesser guesser
30-50	Messer guesser
60-80	Impresser guesser
90-100	Professor guesser

*This is the same as multiplying the right guesses by _____.

II. HOW LOUD WAS THAT?

A. Looking It Over

MEASURING SOUND

(teacher)

This activity and several others call for the sound level to be measured. It may be that the Physics Department has a sound level meter that you can use.

A portable tape recorder can serve as a suitable substitute for the more sophisticated meter, if it has an indicator for sound level. A meter-type indicator is easier to use than a variable intensity light indicator. Make a scale similar to the following. You may use fewer gradations. However, to add additional ones is not suggested.

(From minimum to maximum):

1. Extremely soft
2. Very soft
3. Soft
4. Fairly soft
5. Fairly loud
6. Loud
7. Very loud
8. Extremely loud

Hold the microphone near sounds that you feel are representative of each level. Observe where the needle on the meter goes and mark that place with the appropriate level name.

If you have a device for measuring sound, you are ready for Exploring 1, page 29.

B. Exploring 1

(commentary for teacher)

This experiment is to find out what effect distance from the source has on the loudness of sound. Exploring 1 should suggest to the student that sound decreases as distance increases. This is called an inverse relation.

The procedure is quite simple:

- Hold the microphone to the grill of an automobile (0 paces).
- Have someone "beep" the horn.
- Read and record sound levels on the data sheet.
- Move back ten paces, etc.

Note: A "pace" is 2 steps. If feet are together, step off with left foot. When the right foot next touches down, you have stepped off a pace.

Exploring 1
(students)

Does distance from the source affect the loudness of a sound?

Whatcha think? _____

Got any ideas?

a. Based on your findings, how many paces would you have to take in order not to hear the "beep?"

b. Use your findings to "guesstimate" decibel readings for each loudness value indicated.

c. Could wind have any effect on the experiment? In what way?

d. When it thunders in Atlanta, Georgia, how loud is the sound in North Carolina?

e. Think of some places in the community where noise pollution might discourage people from building houses.

Exploring 2
(commentary for teacher)

Equipment for this experiment consists of a windup alarm clock with a bell, a yardstick, and a device to measure sound (tape recorder).

- Set alarm clock in each place listed on student sheet for Exploring 2 (page 32).
- Place device to measure sound 3 feet from clock.
- Ring bell.
- Record sound level on data sheet.

After the experiment, you might develop a discussion situation based on topics such as:

- "Suppose we consider a carpenter who is using an electric saw in all those places, which would be loudest? Softest?"
- "Mack and Nick are mechanics. Mack works in a large metal airplane hangar. Nick works in an average size room. If they both are hammering on an engine part, which would be louder?"

Exploring 2
(students)

Will the same sound change loudness from place-to-place?

Whatcha think? _____

DATA SHEET

EXPERIMENTER

Place	Loudness
Inside closed closet	
Vacant room	
Crowded room	
Empty hallway	
Gymnasium	
Auditorium stage	

Conclusion:

a. Why did you use the same bell in each place?

b. Why did you record from 3 feet each time?

Exploring 3
(commentary for teacher)

The purpose of this experiment is to find out which "wall" materials reduce the sound level.

Smooth, hard surfaces reflect sound waves. Sometimes the waves bounce back creating an echo. Rough "soft" surfaces tend to break the wave up into many segments. Curtains or drapes are frequently hanging upon walls where there are no windows. The purpose, of course, is to absorb sound.

At this point, we begin to focus in on one of our objectives--that students learn that there are ways of controlling sound.

This experiment involves measuring the sound level where the same source is put into containers of comparable size with different "wall" surfaces.

Exploring 3
(students)

Does the loudness of a sound change when its surroundings change?

Whatcha think? _____

CONTAINER	WALLS	LOUDNESS
Bucket		
Bucket with towel		
Box		
Box with towel		

Select a bucket and a cardboard box of comparable size. You will need a sponge or other soft pad and several towels. The sound source (alarm clock) is placed on the sponge in the bucket.

- Record the level on the sheet above. Repeat for box.
- Now cover the inside walls of the bucket with towels and record the level. Repeat for box.

Note: The walls of the bucket and box may be described as smooth. Walls of towels may be described as rough.

Conclusion:

Got any ideas?

a. Why do you suppose the lobby of a theater is heavily carpeted and has drapes on the walls?

b. Acoustical tiles have small holes in them. Why?

C. Going Beyond (teacher)

1. *Controlling noise*

. The previous experiments should have shown that noise can be controlled to some extent. Some of the ways that have been shown are:

a. distance - move the noise away

b. size of room

c. absorbers

d. diffusers

. To illustrate some applications, you may have someone bring a power mower to school. With the muffler removed, start and let the engine run for a few seconds. Then replace the muffler and run the engine for a few seconds to compare the sound.

. If possible, secure an old automobile muffler. Open it up and have the class discuss how the muffler reduces the sound level.

. Have the class make drawings of a muffler and label the parts.

. Have the class list ways to reduce noise pollution. Give them about five minutes for thinking. Discuss the things they have cited.

The following are some ideas which may be expected:

a. Do not make noise.

b. Block the noise out.

c. Reduce noise by absorbing it.

d. Move the source away.

e. Mask the noise with a more pleasing sound.

. Here are some thoughts for discussion:

a. Some communities have antinoise laws. Does yours? To what noises do they apply?

b. How can airport noises be reduced? (Some jetports use deflectors to turn the noise from jet engines upwards. Work is being done to find ways to muffle jet engines.)

c. Why is music played in some restaurants?

d. What are some ways to reduce noise pollution at school? At home?

C. Going Beyond (Continued)

2. *Shhhhhhh*

You may conclude the unit with an "inactivity." You can begin with the question:

"Can we have too little noise?"

- Ask the class to create as noise-free environment (within the classroom) as possible.
- Ask them to listen for sounds.
- Is "too quiet" a good environment for study?

Let the class discuss their reactions to a noise-free environment.

APPENDIX

Books

CAREER EDUCATION IN THE ENVIRONMENT. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

ENVIRONMENTAL POLLUTION: EXPERIENCES/EXPERIMENTS/ACTIVITIES. New York: Holt, Rinehart, and Winston, Inc. 1971.

THE ENVIRONMENTAL CRISIS. Charles B. Myers. Englewood Cliffs, New Jersey: Prentice-Hall, Inc. Inquiry into crucial environmental problems.

THE DO-IT-YOURSELF ENVIRONMENTAL HANDBOOK. Dayton Museum of Natural History. Ohio: Little, Brown, and Company. $1.95. A good overall book of environmental ideas that are beneficial to the individual.

AIR POLLUTION PRIMER. National Tuberculosis and Respiratory Disease Association. 1969. Free resource and reference material. Available from your local association.

THE ONLY EARTH WE HAVE. Lawrence Pringle. New York: The Macmillan Company. 1969. This book focuses on the problems of water, air, and other pollution problems caused by today's technology. It is well illustrated with photographs.

SCIENCE SKILL TEXTS. Neal and Perkins. Columbus: Charles E. Merrill Publishing Company. 1966. $1.44. Elementary level. Conservation, pollution, activities, and experiments.

POLLUTION. Daniel F. Wentworth, J. Kenneth Couchman, John C. MacBean, Adam Stecher. Mine Publications, Inc., 25 Groveland Terrace, Minneapolis, Minnesota 55403.

ALL AROUND YOU: AN ENVIRONMENTAL STUDY GUIDE. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. $1.50. Ask for Stock No. 2411-0035.

FIELD STUDY GUIDE FOR ENVIRONMENTAL EDUCATION: ELEMENTARY GRADES 1-6, SECONDARY GRADES 7-12. Charlotte/Mecklenburg Schools, N. C.

ENVIRONMENTAL EDUCATION: CONCEPTS, ACTIVITIES, BIBLIOGRAPHY. Free from Division of Science Education, Department of Public Instruction, Raleigh, N. C. 27611. Listing of ideas and things to do, with a bibliography.

OUR NOISY WORLD. John G. Nauarra. Garden City, N. Y.: Doubleday and Company, Inc. 1969. $4.50. Designed for grades K-8.

SCIENCE THROUGH DISCOVERY SERIES. Mildred T. Ballon, et. al. New York: L. W. Singer. 1968. Approximately $4.00. Volumes for grades 5 and 6 have sections on pollution, ecology, and succession.

OUR POLLUTED WORLD. John Perry. New York: Franklin Watts, Inc. 1967. Dramatizes the origins, nature, and disastrous consequences of air and water pollution and questions whether man can continue to dump tremendous amounts of waste into his environment and escape the consequences.

Films

Free films on loan from Association Films, Inc., 2227 Faulkner Road, N. E., Atlanta, Georgia 30324:

"The Litterbug." 7-minute, color. S-996. (Pay only return postage.) A new Walt Disney cartoon motion picture, starring Donald Duck, brings the talents of the world's greatest producer of entertainment for all ages to the fight against litter. The universal appeal of a Disney cartoon makes "The Litterbug" suitable for showing to school groups from kindergarten through high school.

"Toward Cleaner Air." 15-minute, color. F-701. (Pay only return postage.) This film shows how industry is cooperating with local governments to help combat air pollution, now one of the country's major problems. In nontechnical terms, the operation of highly efficient and effective control equipment which traps industrial gases, dust, and waste is explained with animation and graphic diagrams. Also revealed is a secondary value to industry: providing in-plant ventilation and dust control, thereby reducing maintenance and repair costs.

Free films on air pollution on loan from U. S. Department of Health, Education, and Welfare, National Medical Audiovisual Center (Annex), Station K, Atlanta, Georgia 30324: (Order directly from at least two weeks in advance.)

TITLE	ORDER NUMBER
"The Run Around" (Excellent)	M-1774-X
"Beware the Wind"	M-1707-X
"The Poisoned Air"	M-1418-X
"Air of Disaster"	M-1419-X
"Ill Winds On A Sunny Day"	MIS-984
"It's the Only Air We've Got"	M-1431-X
"Air Pollution: Take A Deep Deadly Breath"	
Part I	M-1540-XA
Part II	M-1540-XB
Part III	M-1540-XC
Complete	M-1540-X
"Pollution" (Song Musical Parody)	M-1529-X
"A Day At The Dump"	M-1600-X

Filmstrip

"Man's Natural Environment: Crisis Through Abuse." 2 color filmstrips/2-12. LP records, 32-minute. 1971. Guidance Associates of Pleasantville, N. Y. Discusses the various forms of pollution, the damage they cause, and what is being done about it.

Games

"Pollution." C. Abbot Association, Inc., 55 Wheeler Street, Cambridge, Mass. 02138. Grades 4-6. Approximately $6.00. This is a game designed to teach the social, political, and economic problems that are involved in any attempt to control environmental pollution.

Games (Continued)

"Dirty Water." The Head, Box 4762, Clinton, Iowa 52732. $10.00 plus $1.00 postage. Each player is the water pollution commissioner of an industry-surrounded lake. Designed for upper grade school through adult. 2-4 players.

"Land Use." Education Ventures, 209 Court St., Middleton, Connecticut 06457. $1.95. The game brings out the conflict between the desire to have quality housing and the desire to have natural resources. In developing land, participants discover concepts of cluster zoning, planned unit development, etc.

"Man in His Environment." Free to educators only from your local Coca-Cola Bottling Company. Ask for Ecology Kit Code X013. Not a game in that there is no specific point of completion, but instead, two separate activities requiring the students to role play. Designed for an average class.

"The Pollution Game." Houghton Mifflin Company, 110 Tremont Street, Department M, Boston, Massachusetts 02107. List price, $12.00; school price, $9.00. An environmental monopoly game. The game is meant to be played by competing teams of players, although it works for only one team.

"Smog." The Head, Box 4762, Clinton, Iowa 52732. $10.00 plus $1.00 postage. Players assume the position of air pollution control manager in a growing town. They make decisions which affect their financial status, popularity, and the growth of the town.

"Beat Detroit." Dynamics Design, Inc., Anaheim, California. $8.00. Players must travel 50,000 miles in their new car before going broke or the car falls apart. Played like Monopoly. Possibility that no one will win. Car may be recalled. Kids to adults.

"Indian Valley." Free from the American Forest Institute, 1619 Massachusetts Avenue, N. W., Washington, D. C. 20036. Students put into practice some of the principles which professional forest managers employ. Students divide into teams, each representing a different interest in forest land use, and one represents a multiple-use committee. Teams decide what to do with the forest and present plan to the committee. Game kit contains a map, set of directions for each team, sheets for scoring, and directions for the teacher.

"Land-Use Simulation." Investigating Your Environment Series, U. S. Forest Service, Portland, Oregon. Students decide what to do with a one-square mile of country farmland, four miles from the city. Class divides into groups to prepare a plan for the land. One group is the Board of County Commissioners, who must make the decision based on the presentations by the other groups.

Teaching Aids

Set of teaching pictures. "Ecology: The Pollution Problem." Dramatic, authentic, twenty 12¼" x 17" full color pictures. Also 64-page manual on: "Air, Water Pollution, Soil and Land Pollution, Noise Pollution, Endangered Wildlife, Hope for the Future." No. 61606. Set $4.95.

Teaching Aids (Continued)

"Conservation Packet for Teachers." Request from following sources:

(a) American Forest Products Industries
1816 N Street, N. W.
Washington, D. C.

Includes bulletins, charts, maps, and bad land use.

(b) Soil Conservation Service
U. S. Department of Agriculture
Washington, D. C.

Packet of material on soil and water conservation.

(c) Department of Health, Education, and Welfare
U. S. Public Health Service
Washington, D. C.

A teacher's packet contains information on clean water and pollution control.

(d) U. S. Forest Service
Department of Agriculture
Atlanta, Georgia

Separate teacher packet for elementary and high school.

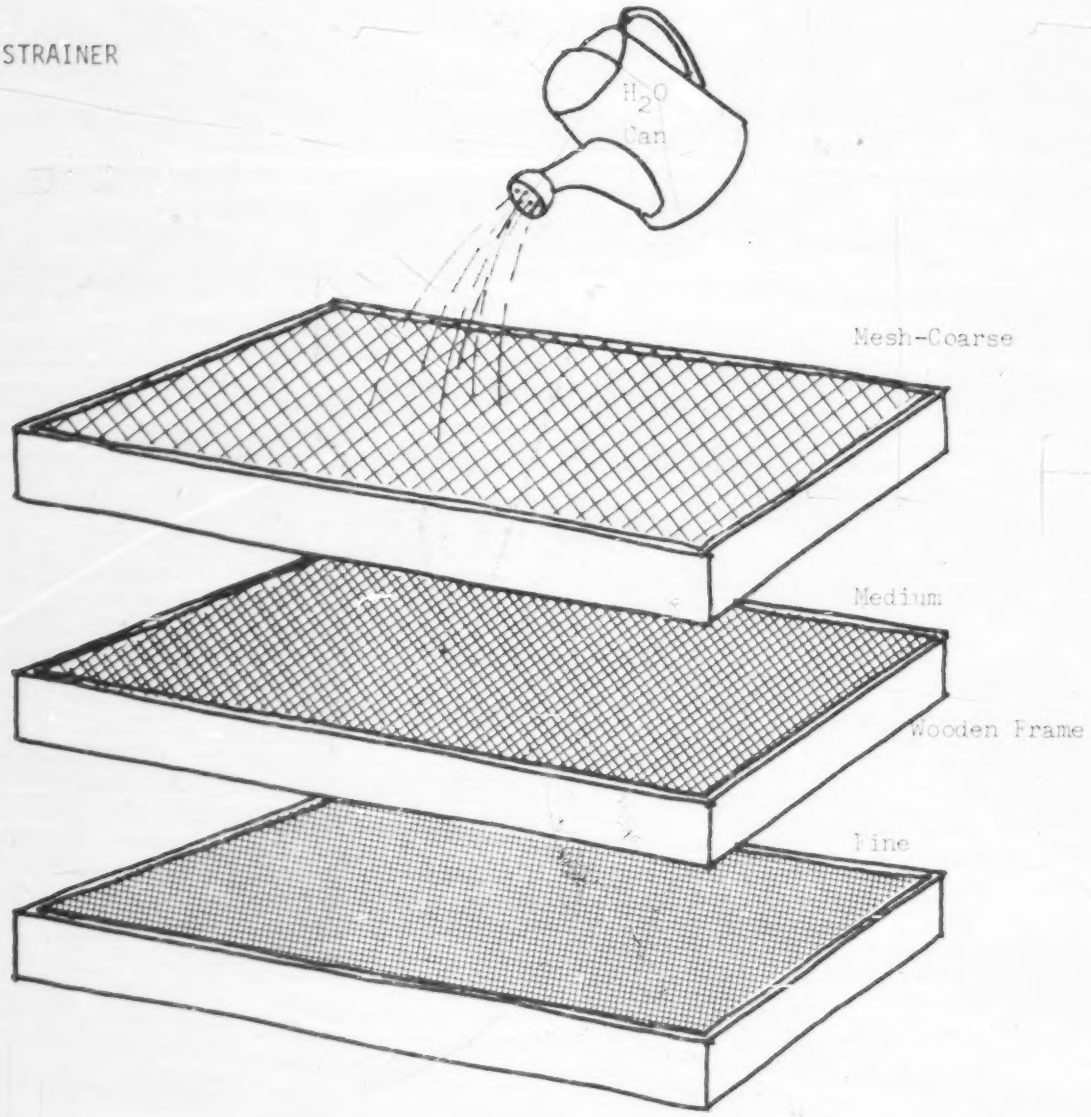
Available from Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:

(a) NO LAUGHING MATTER. A book of syndicated cartoons on air and water pollution. $0.70.

(b) A PRIMER ON WASTE WATER TREATMENT. Current and possible future methods for treating sewage and industrial wastes. $0.55.

(c) "Showdown." Picture pamphlet discussing "showdown" for water quality. $0.65.

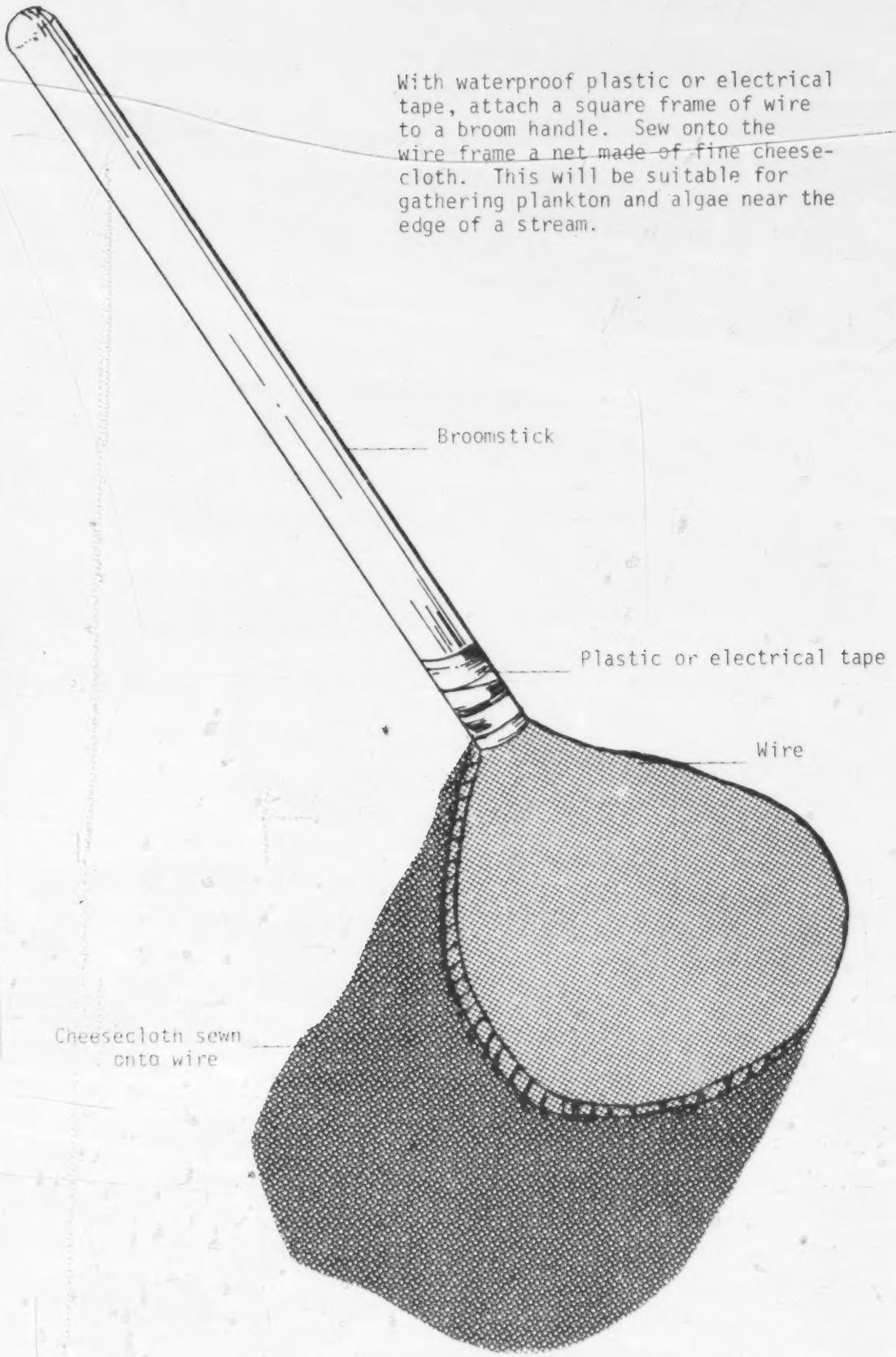
STRAINER



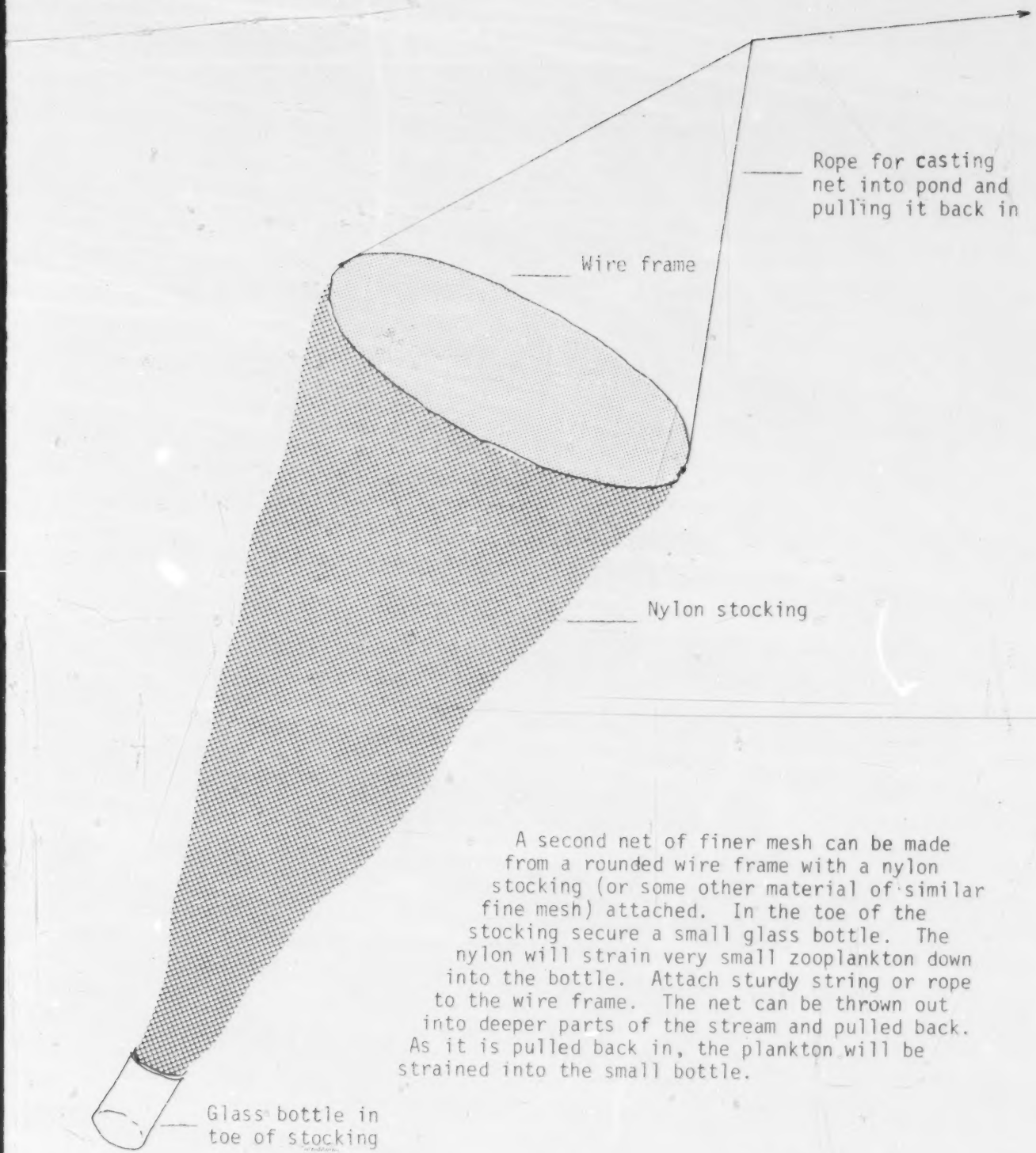
To sift through stream sediment for animal life, a watering can and series of mesh screens on wooden frames are used. The screens can be easily made using a 1" x 4" board and mesh screen that is coarse, medium, and fine in the size of openings. Once constructed, the screens are placed one on top of the other; coarse, medium, and fine mesh on bottom. The mud sample to be sifted is placed on top and a watering can is used to wash away silt, and leave behind on the screens any animals that may have been buried in the mud. Suggested size for screens: 18" square.

PLANKTON NET #1

With waterproof plastic or electrical tape, attach a square frame of wire to a broom handle. Sew onto the wire frame a net made of fine cheesecloth. This will be suitable for gathering plankton and algae near the edge of a stream.



PLANKTON NET #2



A second net of finer mesh can be made from a rounded wire frame with a nylon stocking (or some other material of similar fine mesh) attached. In the toe of the stocking secure a small glass bottle. The nylon will strain very small zooplankton down into the bottle. Attach sturdy string or rope to the wire frame. The net can be thrown out into deeper parts of the stream and pulled back. As it is pulled back in, the plankton will be strained into the small bottle.